CLAIMS

What is claimed is:

1. A method for reducing the acoustical noise, reducing the sonar cross-section or reducing the radar cross-section of an object, comprising covering the object with a polymer which comprises repeating peptide monomeric units selected from the group consisting of nonapeptide, pentapeptide and tetrapeptide monomeric units, wherein said monomeric units form a series of ß-turns separated by dynamic bridging segments suspended between said ß-turns.

2. The method of Claim 1 wherein said polymer is cross-linked.

3. The method of Claim 1 wherein said polymer comprises a block or random copolymer comprising at least two of said monomeric units.

4. The method of Claim 1 wherein said polymer comprises an elastomeric polytetrapeptide or polypentapeptide.

5. The method of Claim 1 wherein said polymer is comprised of pentapeptide monomeric units selected from the group consisting of GVGVP (SEQ ID NO:6, where X^1 is V and X^2 is V), GVGIP (SEQ ID NO:6, where X^1 is V and X^2 is I), GVGFP (SEQ ID NO:6, where X^1 is V and X^2 is F), GFGFP (SEQ ID NO:6, where X^1 is F and X^2 is F), GFGEP (SEQ ID NO:6, where X^1 is F and X^2 is E), GFGIP (SEQ ID NO:6, where X^1 is F and X^2 is I), GEGFP (SEQ ID NO:6, where X^1 is E and X^2 is F), GEGVP (SEQ ID NO:6, where X^1 is E and X^2 is V), GKGFP (SEQ ID NO:6, where X^1 is K and X^2 is F), GKGVP (SEQ ID NO:6, where X^1 is K and X^2 is V), GEGIP (SEQ ID NO: 6, where X^1 is E and X^2 is I), GKGIP (SEQ ID NO: 6, where X^1 is K and X^2 is I) and GYGIP (SEQ ID NO: 6, where X^1 is Y and X^2 is I), alone or in combination.

6. The method of Claim 5 wherein at least one of said pentapeptide monomeric units is GVGVP (SEQ ID NO:6, where X^1 is V and X^2 is V) or GVGIP (SEQ ID NO:6, where X^1 is V and X^2 is I).

7. The method of Claim 1 wherein said polymer comprises at least one pentapeptide monomeric unit having the formula GX^1GX^2P (SEQ ID NO:6), where X^1 is selected from

the group consisting of V, E, F, Y and K; and X^2 is selected from the group consisting of V, E, F and I.

8. The method of Claim 1 wherein said polymer comprises at least monomeric unit containing a phenylalanine, tyrosine or isoleucine residue.

9. The method of Claim 1 wherein said polymer is modified to contain at least one hydrophobically tuned ion-pair dissociable site.

10. The method of Claim 9 wherein said polymer comprises at least one pentapeptide monomeric unit having the formula GX^4GX^5P (SEQ ID NO:24) where X^4 is selected from the group consisting of V, E, F, Y, K, S and T; and X^5 is selected from the group consisting of V, E, F, I, S, T and Y; with the proviso that at least one of X^4 and X^5 is Y, S, or T.

11. The method of Claim 9 wherein said polymer comprises at least one monomeric unit having the formula -GVGVP-X^3-GVGVP- (SEQ ID NO:23) where X^3 in is S, T or Y.

12. The method of Claim 1 wherein said polymer absorbs frequencies within the range of 100 Hz to 100 kHz.

13. The method of Claim 1 wherein the entire monomeric unit or β-turn and suspended segment exhibits a collective motional mode in the low frequency range below 100 kHz.

14. The method of Claim 1 wherein the object is a submarine or ship.

15. The method of Claim 14 wherein said covering comprises coating the hull of the submarine or ship with said polymer.

16. The method of Claim 15 which further comprises covering said polymer coating with a protective non-frequency reflecting coating.

17. A method for reducing the acoustical noise, reducing the sonar cross-section or reducing the radar cross-section of an object comprising covering the object with an amphiphilic petroleum-based polymer, which exhibits lower critical solution temperature behavior and contains at least one hydrophobically tuned ion-pair dissociable site.

18. The method of Claim 17 wherein said polymer absorbs frequencies within the range of 100 Hz to 100 kHz.

19. The method of Claim 17 wherein the object is a submarine or ship.

20. The method of Claim 19 wherein said covering comprises coating the hull of the submarine or ship with said polymer.

21. The method of Claim 20 which further comprises covering said polymer coating with a protective non-frequency reflecting coating.

22. The method of Claim 21 wherein said polymer is selected from the group consisting of acrylamides and esters.

23. A method for measuring the sound absorption capabilities of a protein-based material comprising the steps of: (a) forming a test component from a polymer comprising repeating peptide monomeric units selected from the group consisting of nonapeptide, pentapeptide and tetrapeptide monomeric units, wherein said monomeric units form a series of ß-turns separated by dynamic bridging segments suspended between said ß-turns, wherein the polymer is optionally modified to include a charged site; (b) exposing the test component to a high intensity, low frequency sound; (c) measuring the change in dielectric increment of the test component; and (d) correlating the measured dielectric increment of the test component to the level of sound that would be absorbed by a protein-based material when exposed to the high intensity, low frequency sound.

24. The method of Claim 23 wherein said protein-based material is marine mammal tissue or other biological tissue.

25. A method of measuring the microwave or radar absorption capabilities of a material comprising the steps of: (a) forming a test component from a polymer comprising repeating peptide monomeric units selected from the group consisting of nonapeptide, pentapeptide and tetrapeptide monomeric units, wherein said monomeric units form a series of ß-turns separated by dynamic bridging segments suspended between said ß-turns, wherein the polymer is optionally modified to include a charged site; (b) exposing the test component to microwave or radar exposure; (c) measuring the change in dielectric increment of the test component; and (d) correlating the dielectric relaxation to the amount of microwave or radar absorption that would occur when the material is exposed to microwaves or radar.

26. The method of Claim 25 wherein the method measures the radar absorption capabilities of a protein-based material.

27. The method of Claim 25 wherein the method measures the microwave absorption capabilities of a polymers with hydrophobic hydration.

28. A method of designing polymers that are capable of low frequency acoustic absorption, comprising the steps of: (a) forming a polymer comprised of repeating peptide monomeric units selected from the group consisting of nonapeptide, pentapeptide and tetrapeptide monomeric units, wherein said monomeric units form a series of ß-turns separated by dynamic bridging segments suspended between said ß-turns; and (b) introducing a charged site on said polymer.

29. The method of Claim 28 wherein said charged site is an anionic site.

30. The method of Claim 28 wherein said charged site is a cationic site.

31. The method of Claim 28 wherein said polymer is cross-linked.

32. The method of Claim 28 wherein said polymer comprises a block or random copolymer comprising at least two of said monomeric units.

33. The method of Claim 28 wherein said polymer comprises an elastomeric polytetrapeptide or polypentapeptide.

34. The method of Claim 28 wherein said polymer is comprised of pentapeptide monomeric units selected from the group consisting of GVGVP (SEQ ID NO:6, where X^1 is V and X^2 is V), GVGIP (SEQ ID NO:6, where X^1 is V and X^2 is I), GVGFP (SEQ ID NO:6, where X^1 is V and X^2 is F), GFGFP (SEQ ID NO:6, where X^1 is F and X^2 is F), GFGEP (SEQ ID NO:6, where X^1 is F and X^2 is E), GFGIP (SEQ ID NO:6, where X^1 is F and X^2 is I), GEGFP (SEQ ID NO:6, where X^1 is E and X^2 is F), GEGVP (SEQ ID NO:6, where X^1 is E and X^2 is V), GKGFP (SEQ ID NO:6, where X^1 is K and X^2 is F), GKGVP (SEQ ID NO:6, where X^1 is K and X^2 is V), GEGIP (SEQ ID NO: 6, where X^1 is E and X^2 is I), GKGIP (SEQ ID NO: 6, where X^1 is K and X^2 is I) and GYGIP (SEQ ID NO: 6, where X^1 is Y and X^2 is I), alone or in combination.

35. The method of Claim 34 wherein at least one of said pentapeptide monomeric units is GVGVP (SEQ ID NO:6, where X^1 is V and X^2 is V) or GVGIP (SEQ ID NO:6, where X^1 is V and X^2 is I).

36. The method of Claim 28 wherein said polymer comprises at least one pentapeptide monomeric unit having the formula GX^1GX^2P (SEQ ID NO:6), where X^1 is selected from the group consisting of V, E, F, Y and K; and X^2 is selected from the group consisting of V, E, F and I.

37. The method of Claim 36 wherein at least one of X^1 and X^2 is phenylalanine.

38. The method of Claim 28 wherein said polymer comprises at least monomeric unit containing a phenylalanine, tyrosine or isoleucine residue.

39. The method of Claim 28 wherein said polymer contains at least one residue selected from the group consisting of serine, threonine and tyrosine.

40. The method of Claim 39 wherein said residue is contained within a monomeric unit.

41. The method of Claim 39 wherein said residue is between two monomeric units.

42. The method of Claim 28 wherein said polymer absorbs frequencies within the range of 100 Hz to 100 kHz.

43. The method of Claim 28 wherein said introduction of a charged site on the polymer allows for subsequent formation of an ion-pair dipole.

44. The method of Claim 43 wherein the cation in said ion-pair dipole is selected from the group consisting of alkali, alkaline earth, transition metal ions, lanthanides and actinides.

45. The method of Claim 44 wherein said cation is selected from the group consisting of Na^+, Ca^+, Mg^{+2}, Ba^{+2}, Sr^{+2} and Pb^{+2}.

46. The method of Claim 43 wherein the anion in said ion-pair dipole is selected from the group consisting of carboxylates, phosphates, sulfates, borates and silicates.

47. The method of Claim 46 wherein said anion is selected from the group consisting of $-COO^-$, $-OSO_3^{-2}$, $-OPO_3^{-2}$ and $-OBO_2^{-2}$.

48. A method of designing polymers that are capable of low frequency acoustic absorption, which comprises forming a polymer comprised of repeating peptide monomeric units selected from the group consisting of nonapeptide, pentapeptide and tetrapeptide monomeric units, wherein said monomeric units form a series of ß-turns separated by dynamic bridging segments suspended between said ß-turns, wherein said polymer has one or more of the following characteristics: a mean mass of the repeating unit within the range of 300 to 10,000 daltons; a cross-link density of the matrix within the range of one cross-link per 300 dalton to no cross-links between chains (coacervate state); a water content of the matrix or coacervate within the range of 2% to 99% by weight; a hydrophobicity of the repeating unit within the T_t range of -200°C to 90°C; and a transition temperature within the range of -200°C to 120°C.

49. A protein based polymer for use in reducing acoustical noise, reducing sonar cross-section or reducing radar cross-section comprising a polymer having repeating units and at least one of the following characteristics: a mean mass of the repeating unit within the range of 300 to 10,000 daltons; a cross-link density of the matrix within the range of one cross-link per 300 dalton to no cross-links between chains (coacervate state); a water content of the matrix or coacervate within the range of 2% to 99% by weight; a hydrophobicity of the repeating unit within the T_t range of -200°C to 90°C; and a transition temperature within the range of -200°C to 120°C.

50. The protein based polymer of Claim 49 wherein said polymer is selected from the group consisting of the protein formulas of SEQ ID NO:6, where X^1 is V and X^2 is V and n=251; SEQ ID NO:6, where X^1 is V and X^2 is I and n=260; SEQ ID NOS:8-20 and SEQ ID NOS:29-44.

51. A kit for reducing the acoustical noise, sonar cross-section or radar cross-section of an object, comprising: (a) a polymer comprised of repeating peptide monomeric units selected from the group consisting of nonapeptide, pentapeptide and tetrapeptide monomeric units, wherein said monomeric units form a series of ß-turns separated by dynamic bridging segments suspended between said ß-turns, wherein said polymer has one or more of the following characteristics: a mean mass of the repeating unit within the range of 300 to 10,000 daltons; a cross-link density of the matrix within the range of one

cross-link per 300 dalton to no cross-links between chains (coacervate state); a water content of the matrix or coacervate within the range of 2% to 99% by weight; a hydrophobicity of the repeating unit within the T_t range of -200°C to 90°C; and a transition temperature within the range of -200°C to 120°C; and (b) a material to form a protective coating.

52. The kit of Claim 51 which further comprises a cross linking agent.